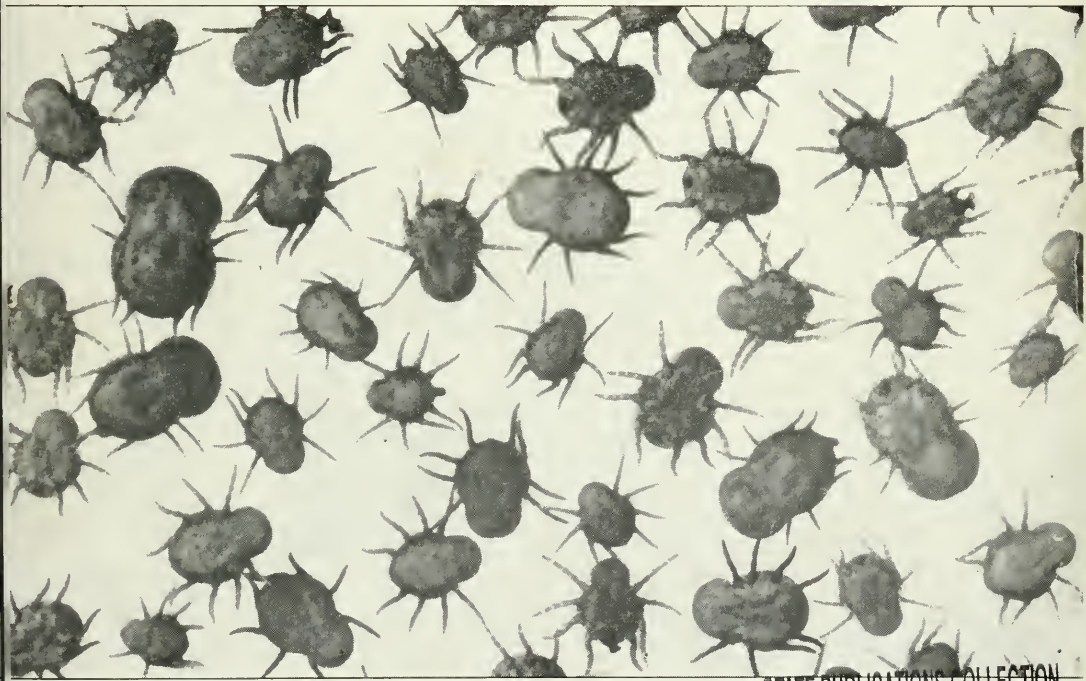
N NO. 408 DECEMBER, 1942

Montana Insect Pests, 1941 and 1942

TWENTY-NINTH REPORT OF THE STATE ENTOMOLOGIST

BY

HARLOW B. MILLS, STATE ENTOMOLOGIST



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MONTANA STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
BOZEMAN, MONTANA

Bozeman, Montana
December 1, 1942.

To His Excellency
Governor Sam C. Ford
Helena, Montana
My Dear Sir:

I am presenting herewith the 29th Report of the State Entomologist of Montana.

The main work of this office deals with protection of crops from injurious insects. In some respects we have been rather fortunate during the past biennium. Mormon cricket infestations have dropped until these pests are of only local interest in a few areas. No widespread grasshopper infestations were present in 1941 and 1942, although some areas developed critical populations. On the other hand, the east slope of the Rockies and the Yellowstone Valley show a considerable increase in possibilities for grasshopper injury in 1943. Coupled with this will be difficulties in obtaining adequate labor, transportation for materials, etc. which will make next year's campaign more difficult than any in the recent past.

Bee inspection was reestablished, after a cessation of eight years, in this office. The first summary of this work is submitted with this report, and I should especially like to call it to your attention. Considering the fact that it started in the spring of 1941 without implementation, personnel, or established policy we are gratified with the large amount of work accomplished.

Respectfully submitted,
HARLOW B. MILLS
State Entomologist

MONTANA INSECT PESTS 1941 AND 1942

Twenty-ninth Report of the State Entomologist

Harlow B. Mills

INTRODUCTION

The insect pests which plague the rancher and farmer in Montana present an ever-changing picture. This is true for at least two reasons. First, the pests of importance are likely to change from year to year, the dry years having their more or less typical complex of injurious forms, and the wet years reducing some of them and making conditions favorable for a new group; further, new pests are appearing in the State bringing with them new problems. Second, in the light of new research findings better control methods are being developed, both in Montana and outside of the State, which necessitate the constant inspection and revision of the approved methods of control. The control of grasshoppers and Mormon crickets is a good example of this. The last decade has seen many advances in our methods of attacking these problems. Survey methods have been developed and refined, bait formulae have been improved and reduced in cost, and the mechanics of mixing and spreading baits have taken great strides forward, largely through the efforts of the United States Bureau of Entomology and Plant Quarantine.

The main efforts of this office have been directed toward the control of the major pests, either through the administration of field control campaigns, or through the preparation of circulars describing approved methods of insect control. More than 300 inquiries on the control of a great variety of harmful animals are received and answered annually.

During the past year 44 single-page pamphlets, many of them illustrated, were prepared by this office and published by the Montana Extension Service. These circulars, Series A, Nos. 1 to 44, are available from County Agents or from the Montana Extension Service, Bozeman, Montana.

Over a period of years the involved states in cooperation with the Bureau of Entomology and Plant Quarantine have developed a good organization for the large-scale control of regional insects of migratory habits. Control operations in Montana, under the joint direction of the State Entomologist's Office and this Bureau,

have involved the suppression of grasshoppers, Mormon crickets, and to a lesser extent the army cutworms. During the past two years Mr. O. B. Hitchcock, Assistant State Entomologist, has taken over most of the direct field supervision. These campaigns have met with considerable success, but as pointed out later in this report, losses actually may be greater during light infestations than during heavy ones. This is primarily a problem of individual interest and participation, and the success of any insect control campaign is the result of the activity of each farmer involved.

The last session of the Legislature provided that the handling of bee inspection problems be a part of the responsibilities of this office. This work was organized and equipped during the spring of 1941. Mr. J. F. Reinhardt of the University of Minnesota was employed as the State Apiarist, and his time has been fully occupied with this work. After a cessation of bee inspection work for several years it was necessary to start almost from scratch, and the large amount of work which has been accomplished during the past two seasons is gratifying. The success and value of this activity will become more apparent as time goes on. The first summary of Mr. Reinhardt's work is included in this report.

MAJOR INSECT CONTROL PROBLEMS

GRASSHOPPER CONTROL, 1941-42

O. B. Hitchcock, Assistant State Entomologist

The migration of the lesser migratory locust *(Melanoplus mexicanus)* has been of great importance and interest since the extremely heavy infestation of July, 1938. As reported in the Twenty-seventh and Twenty-eighth Reports of the State Entomologist[1] the movements of these insects for 1938, 1939, and 1940 were as follows: the flights which originated in North and South Dakota first entered eastern Montana on July 1, 1938, and migration continued during much of the summer. The egg bed for 1939, laid down by the migrants, covered most of the northeastern part of the State including all of Garfield, Richland, McCone, Roosevelt, and parts of Valley, Daniels, Dawson, Prairie, Custer, Rosebud, Treasure, Musselshell, Petroleum, and Phillips counties (figure 1).

In 1939 the 'hoppers, after becoming adults, migrated into the north-central part of the State and a smaller area in the south-central part where they laid large numbers of eggs for the 1940 generation.

The 1940 migration was west until the 'hoppers reached the Rocky Mountains and the heaviest egg depositions in 1941 were in Cascade, Chouteau, Pondera, Teton, Toole, and Liberty counties.

[1]Mont. Exp. Sta. Bul. 336, pp. 12-16, 1939.
" " " " 384, pp. 1-5, 1941.

This area was considerably smaller than that infested during the two previous years and the intensity of infestation was not so great.

There were no recorded migrations or flights of economic importance during the 1941 season. Some small local movements were observed in Pondera, Teton, and Cascade counties and some light flights entered Judith Basin, Liberty, and Hill counties.

The only movement of *M. mexicanus* observed in the State in 1942 were small localized flights from northern Yellowstone and eastern Stillwater counties into the Yellowstone Valley and local dispersals in Big Horn County and other areas.

From 1938 to 1940 the grasshopper migration progressed mostly in a northwest and westerly direction. Each year there was a de-

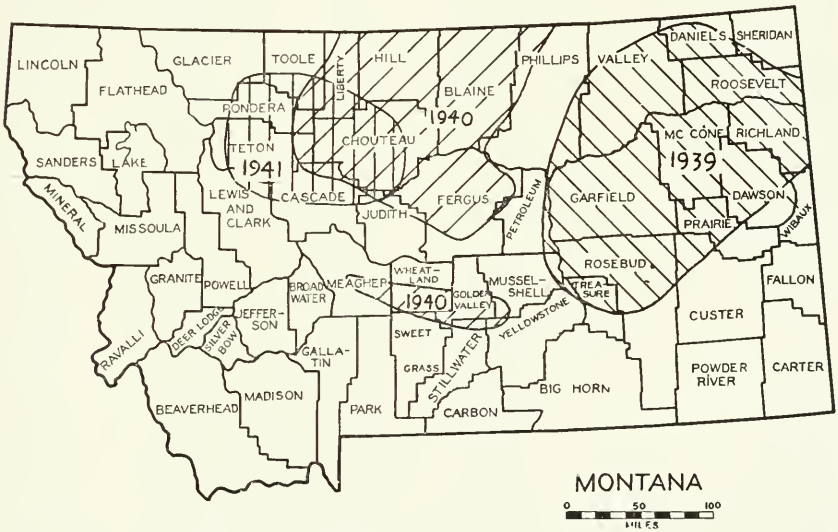

Figure 1. Grasshopper egg beds, 1939 to 1941.

crease in extent and degree of infestation until the Rocky Mountains were reached in 1940. Since that time no comparable migrations have been observed.

It has been interesting to note, especially since 1939, that there has been a marked decrease in intensity of 'hopper populations, apparently due to unfavorable weather conditions, other natural factors, and intensified control work. Regardless of these adverse factors the numbers of 'hoppers present each year have been great enough to be a serious threat to crops. It seems that the tremendous populations that were present in 1938 and 1939 have made it possible for the 'hoppers to maintain a threatening condition due largely to sheer weight in numbers.

Grasshopper adult and egg surveys made in the fall of 1940 indicated that outbreaks were likely to occur in the south-central and northern half of the State, east of the Divide, with the most severe areas being in Sheridan, Daniels, Roosevelt, Valley, Phillips, Blaine, Hill, Toole, Pondera, Teton, Cascade, Wheatland, Musselshell, Yellowstone, Treasure, and Rosebud counties.

The first reports of eggs hatching were received on May 8 but the general hatch in the south and central part of the State did not occur until May 15. In the northeastern counties no large hatches were observed until May 24.

TABLE 1. CROP LOSSES FROM GRASSHOPPERS AND SAVINGS FROM CONTROL WORK IN DOLLARS

	1941		1942	
County	Loss	Savings	Loss	Savings
Beaverhead	1,200	5,000	—	—
Big Horn	5,650	51,900	416,750	285,425
Carbon	—	—	31,310	22,800
Cascade	165,850	69,350	21,700	29,800
Chouteau	64,000	125,000	5,300	9,500
Custer–Powder River	—	—	—	3,175
Daniels	900	200	—	—
Dawson	3,500	650	75,500	5,700
Fergus	200	500	—	—
Flathead	33	44	—	—
Garfield	10,350	2,950	67,750	250
Glacier	21,050	7,320	6,150	8,950
Golden Valley–Musselshell	127,350	239,500	226,000	76,000
Hill	25,000	177,500	—	—
Judith Basin	85,200	2,900	23,300	—
Lake	1,800	2,450	—	—
Lewis and Clark	3,434	300	—	—
Liberty	6,250	18,000	—	—
McCone	—	—	108,000	75,350
Meagher	2,450	—	—	—
Petroleum	9,500	1,850	—	—
Phillips	—	250	—	—
Pondera	495,825	2,515,700	8,700	25,450
Powell	8,250	1,585	—	—
Prairie	9,950	3,500	107,000	6,500
Richland	800	300	22,100	50
Roosevelt	9,600	10,000	—	—
Rosebud	3,250	395	65,200	22,600
Sanders	8,700	24,000	—	—
Stillwater	16,600	2,750	67,500	18,005
Sweet Grass	2,000	10,000	7,350	8,700
Teton	214,200	614,700	76,000	61,000
Toole	18,700	63,850	1,950	4,350
Valley	16,200	23,165	6,500	1,275
Wheatland	2,500	1,000	—	—
Yellowstone	26,500	254,800	256,635	155,441
TOTAL	1,420,292	4,231,409	1,599,695	817,671

A three-week period of cool, damp weather during May and June over much of the State caused the hatch to be uneven and somewhat delayed, especially in Sheridan, Daniels, Roosevelt, Valley, Phillips, Blaine and Hill counties. It is thought that these weather conditions may have caused many young 'hoppers to die and may have damaged some eggs so that they did not hatch. It is quite evident that some natural control took place because the infestation in this area was not nearly so severe as indicated by the survey.

Pondera was by far the most severely infested county in the State. The estimated crop savings realized from the control program was over 2½ million dollars compared with slightly less than ½ million dollars damage. Seven hundred sixty-four farmers spread 1441 tons of mixed bait over 177,500 acres of land in the county.

Other counties which had heavy infestations of grasshoppers and put out large quantities of bait were Teton, Toole, Chouteau, Cascade, Hill, and Yellowstone (see table 1).

The control program over the State was, in most cases, quite successful. The estimated savings as a result of the work done was nearly 4½ million dollars compared with less than 1½ million dollars' damage. Three thousand three hundred twenty-five farmers spread 3,668 tons of bait over 671,420 acres of land. The total county expense in putting on the program was $20,007—the farmers contributed $50,978, and the Federal Government spent $108,525 for 'hopper control in the State, making a total cost of $179,511.

The dominant species in most parts of the State was *Melanoplus mexicanus* with *M. bivittatus* ranking second in importance. In the north-central part of the State *M. packardi* was second to *M. mexicanus* as the dominant species. It also occurred in large numbers in Stillwater County. Heavy populations of *M. differentialis* were found in small areas in Wheatland, Prairie, and Big Horn counties. In spots in Yellowstone and Big Horn counties *M. femur-rubrum* was observed in large numbers. Heavy concentrations of *Disosteira carolina* were found in Golden Valley County.

The vegetation along the margin of fields and on idle and abandoned land was quite heavy and remained green most of the summer. Because of the abundance of feed there was little migration of grasshoppers into crop land until almost time for harvest so that little damage was done to winter wheat.

In the eastern part of the State large numbers of *M. bivittatus* and *M. differentialis* were recorded dying from what appeared be a fungus or bacterial disease. It was observed that blister beetle larvae had destroyed many 'hopper egg pods in the south-central counties. No other reports of parasites or predators reducing grasshopper populations were received.

A period of continued cool, wet weather during much of August, September, and October was unfavorable for grasshopper

egg deposition. There is little doubt that these conditions were important in reducing the 'hopper problem the following year.

The grasshopper situation in 1942 was less severe over most of the State than it has been for the last five years. This was due largely to a smaller number of eggs in the soil, and to the

TABLE 2. SUMMARY OF BAIT USAGE

County	1941			1942		
	Tons bait dry wt.	No. farmers using bait	Acres baited	Tons bait dry wt.	No. farmers using bait	Acres baited
Beaverhead	1.4	5	250	——	——	——
Big Horn	75.0	149	14,800	184.0	100	34,000
Broadwater	.25	2	50	——	——	——
Carbon	——	——	——	13.0	30	2,933
Cascade	173.0	445	27,500	27.3	72	11,600
Chouteau	308.0	190	37,000	5.2	50	1,200
Custer-Powder River	——	——	——	5.9	21	1,368
Daniels	1.0	2	100	——	——	——
Dawson	4.0	8	325	4.25	17	820
Fergus	5.0	32	270	——	——	——
Flathead	.5	5	60	——	——	——
Gallatin	1.3	5	250	——	——	——
Garfield	2.0	3	340	5.5	30	1,200
Glacier	.75	5	130	——	7	520
Golden Valley–Musselshell	10.0	94	2,000	13.1	532	2,500
Hill	143.0	125	40,000	——	——	——
Judith Basin	12.0	49	1,940	——	4	10
Lake	13.25	12	1,400	——	——	——
Lewis and Clark	1.0	6	134	——	——	——
Liberty	140.0	100	20,000	——	——	——
McCone	——	——	——	107.3	46	20,840
Petroleum	2.0	8	266	——	——	——
Phillips	1.0	5	80	——	——	——
Pondera	1,441.8	764	177,500	5.55	17	2,740
Powell	1.24	9	119	——	——	——
Prairie	2.0	8	730	22.5	33	3,110
Richland	2.0	15	10	——	10	5
Roosevelt	4.0	28	10,765	——	——	——
Rosebud	3.5	20	17	3.0	75	1,733
Sanders	56.0	35	7,200	——	——	——
Stillwater	10.0	16	2,650	8.7	42	3,540
Sweet Grass	1.4	8	285	4.0	11	500
Teton	539.0	525	130,300	28.7	48	3,600
Toole	385.0	175	45,000	7.0	10	1,654
Treasure	45.0	25	8,500	——	——	——
Valley	84.0	34	10,499	4.5	6	375
Wheatland	6.0	13	500	——	——	——
Yellowstone	193.0	400	95,200	242.1	429	62,600
TOTAL	3,668.39	3,325	636,170	691.60	1,590	157,773

fact that cool, wet weather during the spring months delayed the hatch and development of the 'hoppers to such a degree that their presence was not especially apparent until most crops were harvested or so far advanced that the damage to them was not noticed. As a result of this and the extreme shortage of labor comparatively little control work was carried on.

A comparison of the 1941 program with 1942 in table 3 indicates that as the grasshopper menace deceases there is a tendency for farmers to neglect control work. In 1941 there were nearly twice as many counties participating in the control program, over twice as many farmers taking part and over five times as much bait used as there was in 1942. The lack of interest and cooperation in years of light infestations often causes them to be more costly than years of heavy populations as is shown in table 3. In 1941, a year of comparatively heavy infestation, the estimated damage caused by 'hoppers was approximately $179,000 less than the estimated damage in 1942, and the estimated savings from control work in 1941 nearly 3½ million dollars more. Besides the losses

TABLE 3. SUMMARY OF GRASSHOPPER CONTROL PROGRAM

	1941	1942
No. Mixing Stations	32	23
Counties actively engaged	32	19
Farmers using bait	3325	1590
Dry bait used	3668.39	691.6
Acres baited	671,420	157,773
Estimated loss	$1,420,292.	$1,599,695.
Estimated savings	$4,231,409.	$817,671.

sustained in years of lighter infestations the populations are allowed to build up for more serious situations in following years. If the light and incipient infestations were controlled greater savings would be made with relatively small cost.

The areas in the State which were most heavily infested with grasshoppers were northwestern Yellowstone, southern Musselshell, southeastern Golden Valley, and northeastern Stillwater counties in the vicinity of Broadview, Acton, and Rapelje; northeastern Rosebud, southeastern Garfield, southwestern Prairie, and northwestern Custer in the vicinity of Rock Springs and Crow Creek; and southern McCone County. The Camas Prairie and Lonepine areas in Sanders County and most of Big Horn County were also heavily infested.

Cool, wet weather during most of May and June caused the hatch over most of the State to be quite late and uneven. The first general hatch occurred about June 15. Nymphal development was also delayed by the unfavorable weather conditions.

The dominant species over the State was *M. mexicanus*, with *M. bivittatus* second in importance. Other species were not ob-

served in numbers large enough to cause any great amount of injury.

It is estimated that cool, wet weather during the spring months reduced the grasshopper populations from 5 to 25 per cent. The heaviest mortality was in the northeastern and northern parts of the State. In the Gibson area of Sweet Grass County approximately 30 per cent of the *M. bivittatus* adults were killed by fungus. Other areas where fungus or disease killed large numbers of 'hoppers were in Fallon, Valley, Custer, Roosevelt, Pondera, Cascade, and Teton counties.

Sarcophagid flies were numerous over must of the State but indications are that they did not parasitize a high per cent of the 'hoppers. In Roosevelt and McCone counties large numbers of grasshopper egg pods were found parasitized by beefly and blister beetle larvae.

GRASSHOPPER OUTLOOK FOR 1943

The 1942 grasshopper egg survey indicates that the 1943 infestation in most parts of the State will be spotted and not so severe as in the past five years. The most severely infested area will probably be in Big Horn, Yellowstone, Stillwater, Golden Valley, and Musselshell counties. Other counties which may have smaller local areas with heavy 'hopper populations are Dawson, Fergus, Judith Basin, Teton, and Toole. In addition to the above it may be necessary to carry on control work in Pondera, Cascade, Chouteau, Lewis and Clark, Wheatland, Sweet Grass, Sanders, Carbon, Treasure, Rosebud, Garfield, Prairie, Custer, Fallon, Wibaux, McCone, Richland, Roosevelt, Valley, and Phillips counties.

In addition to controlling severe infestations and preventing heavy crop losses, the aim of the coming grasshopper campaign should be to control all small incipient outbreaks to prevent serious infestations from developing during the present period of emergency.

The following are some of the unusual problems which will face those involved in control campaigns in 1943. The acute labor shortage will add to the difficulties of some counties in obtaining workers for the mixing stations, in baiting large areas, and in practicing proper cultural control methods. There will no doubt be an increase of idle and abandoned land. There may be a shortage of control materials and of transportation to the areas needing them. Equipment for mixing and spreading bait will not be readily available.

These problems make the situation serious especially at a time when the production of food is so essential. All interested parties

should recognize these problems and help to reduce their importance as far as it is humanly possible to do so.

MORMON CRICKET CONTROL, 1941-42

O. B. Hitchcock, Assistant State Entomologist

During the last two years the Mormon cricket infestation throughout the State has decreased to such an extent that it is no longer the major insect problem that it was.

In 1941 there were five counties with cricket populations high enough to make control measures necessary. These infestations were in Beaverhead County west of Monida near the Montana-Idaho line; Big Horn County east of Lodge Grass and Owl Creek and Sioux Pass, and southwest of Hardin in the vicinity of Beauvais Creek; near Pryor; Chouteau County in a large area including Highwood, Geraldine, Square Butte, and Montague; Sanders County in Fairy Basin, McDonald Basin and in the hills east of Camas Prairie; and in Yellowstone County along Pryor Creek, Hay Creek, Blue Creek, Fly Creek and surrounding area.

The infested areas in Beaverhead and Sanders counties were relatively small and after the control work was completed only a few scattered crickets could be found, with exception of the high areas in Beaverhead County, where heavy populations occurred. The populations in other infested areas were not so heavy as in previous years but were quite extensive and control work was done on a crop-protection basis. Because of the control program very little crop damage occurred.

Until 1939 the use of bait was not recommended as an effective method of controlling Mormon crickets; however, the use of sodium fluosilicate as the active agent instead of sodium arsenite was proved successful, and since 1939 the amount of bait used has increased steadily until this year when its use almost entirely replaced the use of sodium arsenite dust. The bait has many advantages over the dust in that it is more effective, easier and less dangerous to handle, cheaper, and the hazard of livestock poisoning is greatly decreased. The first hatching of Mormon cricket eggs in 1941 was reported in Big Horn County on March 31. The main hatch over the State, however, did not occur until about the 15th of April.

In Yellowstone County a few eggs were found to be parasitized by *Sparaison pilosum* Ashm. The predatory wasp *Palomedes laeviventris* Cress. was observed in most of the infested areas but was not numerous enough to be important in reducing the population of Mormon crickets.

No extensive migrations were observed. However, there was some movement of small bands of crickets out of the Wolf Moun-

tains into crops in the Owl Creek and Sioux Pass areas in Big Horn County.

In 1942 it was necessary to carry on Mormon cricket control work in only two counties in the State. These infestations were located on Owl Creek and Sioux Pass east of Lodge Grass, on Beauvais Creek in Big Horn County and in the southeastern corner of Yellowstone County east of Pryor Creek.

To prevent reinfestation of the lower lands it was thought that a control program would be needed in Beaverhead County west of Monida, in the vicinity of Beaver, Big Beaver, and Poison creeks, near the Montana-Idaho State line. The 1941 campaign was successful to the extent that the only crickets left in this area were on the Continental Divide at about 7,800 feet elevation. In the fall of 1941 this area was visited and large numbers of crickets were observed. Again in the early summer of 1942 the area was scouted and only an occasional cricket could be found so that control work was not necessary. Since it seemed unusual that there were no crickets where such large numbers of adults had been found the previous fall, another investigation was made in September of 1942. It was found that there are large numbers of eggs in the ground and that this is apparently a "hold-over" area where the eggs hatch in two years.

TABLE 4. SUMMARY OF MORMON CRICKET CONTROL, 1941 and 1942

	1941	1942
Crop savings	$87,290	$38,750
Crop losses	$2,680	$1,200
Crop acres protected	46,160	22,038
Acres injured	4,635	890
Crop acres infested	172,800	14,196
Range acres infested	1,007,340	569,758
Total infested	1,180,140	583,954
Acres dusted	3,757	912
Acres baited	24,419	6,873
Pounds mixed dust	17,396	5,945
Pounds mixed bait (dry weight)	197,043	110,706

In 1939 the first discovery of the hold-over phenomenon was made in the Big Horn Mountains in Wyoming. At this time it was found that Mormon cricket eggs laid at high altitudes often require two years to hatch. Ordinarily Mormon cricket eggs laid in the summer or fall hatch the next spring. In a "hold-over" area, however, they remain in the ground for two winters and a summer before hatching.

From the eggs that were collected in Beaverhead County in the fall of 1942 it was found that 60 per cent were viable and contained well developed embryos, 10 per cent were not viable, and 30 per cent had been parasitized by *Sparaison pilosum*.

On investigation of the eggs it was also found that parasites

which emerged from eggs that were attacked in the fall of 1941, were apparently able to successfully parasitize eggs that had escaped the year before. This gave *S. pilosum* two chances at the same set of eggs. Regardless of this high degree of parasitism there appear to be enough viable eggs left to cause a serious infestation for 1943.

The first hatching of Mormon cricket eggs was observed in Big Horn County during the first week of April. The hatch was irregular and continued over several weeks due to the long period of cool, wet weather which prevailed over most of the State during April and May. Adult crickets were observed about the middle of June and egg deposition began early in July.

Except in the Beaverhead area the egg parasite, *S. pilosum*, did not occur in large enough numbers to greatly reduce the infestation. The predatory wasp Palmodes was not observed in sufficient numbers to be of importance in reducing the number of crickets. In Big Horn and Yellowstone counties crows, hawks, blackbirds, and magpies were observed feeding on crickets. Relatively few migrations were observed during the season. In most cases the crickets remained in the general area where hatching occurred.

Indications are that little control work will be necessary in 1943. Possibly a small amount of baiting will be needed again in Yellowstone and Big Horn counties. The Beaverhead County infestation should be watched carefully to prevent reinfestation of the lower lands. The Mormon cricket population in northern Glacier County seems to be increasing and some work may be necessary there.

STORED GRAIN INSECTS

Figure 2. Granary weevil, greatly enlarged.

Two surveys of the State have been made, one in 1941, and the other in 1942, to obtain information on the species of grain pests present in the State, their distribution, and the factors affecting their abundance. These pests are much more widely distributed and much more common in grain storage than was suspected. They are a real problem under certain conditions, and may at times become limiting factors in the marketing of stored materials of this sort. Harvesting during both the 1941 and 1942 seasons was carried out under difficult conditions and in both years a great deal of grain went into the granaries with a greater moisture content

than desirable. As the amount of grain going into storage and as the length of time it is kept in storage increases, we can expect continued increase in the importance of stored grain pests of all kinds.

The more common of these pests are discussed in the Twenty-eighth Report of the State Entomologist, Montana Agricultural Experiment Station Bulletin 384 on pages 12 to 16. Single sheet leaflets dealing with these insects are also available from the Montana Extension Service, and may be obtained by asking for Circular Series A—18, 21, 24, 32 and 43.

Figure 3. Sawtooth grain beetle. Greatly enlarged.

OTHER IMPORTANT INSECT PESTS, 1941-42

NEW INTRODUCED LIVESTOCK PESTS

PRIMARY SCREW WORM.— The adult primary screw worm *(Cochliomyia americana* C. and P.*)* is a bluish-green fly with a striped thorax. It is a little larger than a housefly, and when at rest the wings are held a little more directly over the back than in the house fly or the larger blue bottle flies.

Montana is far out of the normal range of this pest, and its appearance in this State in the summer of 1941 came as a surprise. Apparently it gained entrance to Montana in the early spring of that year through the introduction of cattle imported from Mexico. No reports of this pest were received during 1942, and it is most unlikely that it would be able to stand the rigors of the winter in this latitude. Trouble, then, would be expected only from southern cattle brought into the State and from native cattle running with or near them, and this difficulty would end with the advent of winter. Some loss was experienced throughout the summer of 1941, and possibly it may be years before it again appears in our region.

Figure 4. Primary screw worm taken from a calf near Custer, Montana. Enlarged.

The adult females lay their eggs in the wounds of many domesticated animals, injuries such as those caused by barbed wire,

tick feeding, needle grass, dehorning, castration, branding, etc., and they may also attack the navel of newborn calves. Humans are occasionally attacked and there are a number of records of nose or ear infestations in man.

These flies have a great ability to reproduce. A female may lay approximately 3,000 eggs in batches of from 10 to 400. Three hundred may be laid in from four to six minutes. The eggs hatch in less than a day under usual conditions, and the larvae complete their growth in from three and one-half to four and one-half days. Fully developed larvae (figure 4) drop to the ground where the transformation to the adult takes place. Under the best of conditions a complete generation may develop in about 11 days. It is, then, possible for many generations to appear even under Montana conditions, and for very heavy infestations to occur in the host animals.

The primary screw worm is found throughout the southern states and far into South America. The 1941 Montana records were from Yellowstone and Treasure counties where in August the maggots were taken from the navel of a three weeks-old calf. According to information received from the rancher another calf had a severe infestation in a fresh brand and seven out of eight castrated calves in one group became infested. The area involved Meyers, Custer, and Big Horn, and included stock belonging to thirteen different ranchers. Forty-four animals were known to have been attacked and several of the ranchers merely listed their stock as being infested, with no numbers of animals given. Cattle, horses, pigs, and dogs suffered injury.

While this is the first record of the primary screw worm in the State it is entirely possible that this pest has been brought into Montana at other times. As has been previously pointed out, the chances are that it cannot survive the winter here, and our problem is one of continuous introduction. Most of the cases in 1941 occurred from the last of July to September 15th, indicating that it took some time for the infestation to develop to a size which was readily noticeable, for the suspected introduction of the maggots dated back to April 18, with the arrival of the Mexican cattle.

It is important that future shipments of southern cattle into Montana should be thoroughly examined for wounds which might possibly be infested with this insect. Any maggots which may be recovered from such situations should be sent, preferably alive, to the Department of Zoology and Entomology, Montana Agricultural Experiment Station, Bozeman.

SPINOSE EAR TICK.– This tick *(Otiobius megnini* Duges*)* is primarily a southern pest. In the United States it is most common in the southwest, but it has been reported from as far north as Iowa, Alberta, and Oregon. Concerning these ticks in Canada, Hearle says that they "probably were introduced on imported animals and fortunately they do not appear to have become established."

South of the United States the species is known from Mexico, Central and South America, as well as other parts of the world.

The first Montana record of the spinose ear tick was based on specimens collected near Park City in February, 1916, under conditions which indicated that it had been present for several years. This was reported in the Fourteenth Report of the State Entomologist, Montana Agricultural Experiment Station Bulletin 112, page 67 (1916). As many as 109 ticks were taken from the ears of one calf at that time. Apparently the infestation disappeared, for this pest was not again reported until the spring of 1941, when specimens were submitted by Dr. W. J. Butler, State Veterinarian, which were collected from the ears of Mexican cattle that had been shipped into the upper Yellowstone Valley. Since then several lots of specimens have been examined.

The spinose ear tick is known to attack cattle, horses, sheep, cats, and occasionally man. Its life history, as it is known, is as follows: the newly-hatched, tiny, six-legged seed ticks enter the ears of the animals attacked and attach themselves well below the hair line. In a week or two they become engorged and shed their skins, becoming eight-legged nymphs which bear little resemblance to the first stage. These nymphs are covered with small spines, and are constricted somewhat across the middle (see cover illustration). Ticks in this stage remain in the ears for from one to seven months when they drop to the ground, crawl into dry, protected places, and shed their skins a second time. This moult produces the adults. which are spineless and somewhat flattened. It is not believed that the adults attach to any animal or take food of any kind. Mating and egg laying then take place and under favorable conditions the eggs may hatch in 10 days. Soon after, the little ticks are ready to attach to any of their hosts, settle down in the ears, and continue the life cycle. They may live for three months if no host is found.

The factors which limit the spread or continued development of this pest are unknown, but judging from previous experience, and in spite of the lack of specimens received in 1942, it might remain for some time before it disappears.

A few ticks in the ears of an animal probably do little damage. However, when gross infestations exist considerable injury may occur. The ticks and ear secretions may completely plug the opening and some of them may move as far in as the ear drum. The infested animal usually shakes its head and moves it from side to side. There is a tendency to rub or scratch the ears when the irritation is intense, and young animals often run as if attempting to relieve the nervous tension. Infested animals do not do well. Some of them lose flesh and, rarely, the calves may die.

Because of the point of attachment of the ticks, ordinary dipping will not remove them. A mixture of 2 parts of pine tar to

1 part of cottonseed oil injected at the rate of about ½ ounce per ear, with a warm syringe, is recommended by Imes This mixture kills the parasites present and protects against reinfestation for about a month. In cases where an infestation is suspected, the animals should be examined, and if no ticks are visible the ear should be probed with a piece of bailing wire. A loop should be formed in the end of the wire to prevent injury to the ear.

Montana records are all from the southeastern part of the State, Park City, Biddle, Custer, and Mission.

MISCELLANEOUS RECORDS AND OBSERVATIONS

SAY'S STINKBUG.— This large, green stink bug, *(Chlorochroa sayi* Stal*)* has been locally abundant in the State for the last ten years, and has caused considerable local and sporadic damage to wheat. In 1940 it was seen in numbers as far east as the North Dakota line, but in 1941 and 1942 it was conspicuously rare over much of the previously infested territory. During the past year but one specimen was seen on the study plots at the North Montana Branch Station near Havre.

In June, 1941, some terminal growth of potato vines in Yellowstone County suffered from the attack of Say's stinkbugs. As many as ten specimens per plant were noted. No similar infestations were found in the same area during 1942.

CORN LEAF APHID.— During the late summer of 1941 the corn leaf aphid (*Aphis maidis* Fitch) was sent in from Glasgow and Hardin, and was seen in other areas in the eastern part of the State. In the infested fields this bluish-green plant louse was very abundant on leaves, causing considerable curling. Apparently it was not a problem during the 1942 season.

This pest attacks corn, millet, broom corn, sorghum, and Sudan grass. In the southern part of the United States it winters on barley, but it is not known where the winter is spent in our area, nor has its life history been worked out completely. It is usually not an important pest, and adequate control measures are not known.

THE POTATO AND TOMATO PSYLLID.— The 1941 adult populations of this pest (*Paratrioza cockerelli* Sulc.) were alarmingly high in early potatoes until checked by very high temperatures from July 16-19. Slight reductions in yield resulted in some areas. Growers have gradually become less 'psyllid-conscious' since the outbreak of 1938 and reduced yields are commonly attributed to other causes.

Early season populations of psyllids were low in 1942. In the Yellowstone Valley potato fields planted during April and the first half of May showed symptoms of psyllid yellows by early July, and some reductions in yield resulted. A general outbreak was apparently checked by high temperatures in July, when half the

days showed temperature maxima above 90° F. Fields planted after June 1 remained rather uniformly free from psyllids and the psyllid yellows disease.

Vines infected by psyllid yellows were seen in potato plantings in Jefferson, Gallatin, Carbon, and Big Horn counties, in addition to the Yellowstone Valley plantings from Laurel to Glendive.

RED HUMPED APPLE CATERPILLAR.—During the past few years requests for information on the control of the red humped apple caterpillar (*Schizura concinna* S. and A.) have been received in increasing numbers. Although these caterpillars are striking and conspicuous, they are of but minor importance and only locally are of sufficient abundance to warrant control measures.

When fully developed, the larvae have a reddish-yellow appearance due to the alternating stripes of these colors on the body. These stripes are more conspicuous on the sides. Slender, dark, pointed processes occur along the back, and are most conspicuous on the segments just behind the head. One of the segments toward the head is enlarged and red, and from this structure the insect gets its common name. When irritated the rear end of the body is raised considerably above the surface upon which the larvae is standing. Because they are voracious eaters, feeding openly on leaf tissue, they can be controlled without difficulty by the usual lead arsenate sprays.

All of our Montana records are from the western third of the State, Big Fork, Deer Lodge, Dixon, Heron, Kalispell, Ronan, and Troy, and all observations were for the month of August but one, in September.

DIAMOND BACK MOTH.— The larva of this little moth (*Plutella maculipennis* (Curt.) attacks cabbages, mustard, and related plants. While it is widespread in Montana, its attack on garden crops is usually so slight as to be hardly noticeable, and only occasionally does it become so abundant as to require control.

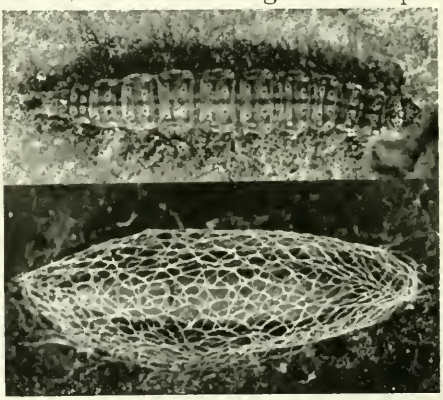

Figure 5. Diamond-back moth, larva above, cocoon below. Greatly enlarged.

Recently, however, it became abundant in large plantings of commercial mustard in the north-central part of the State, and during the summer of 1941 it damaged acreages of this crop by boring into the pods and destroying the seeds. It was very abundant that season also on several species of wild mustard, notably tumbling mustard (*Sisymbrium altissimum*).

SUGAR BEET WEBWORM.— The occurrence of this insect (*Loxostege sticticalis* (L.)) was quite general throughout the State in 1941. Heavy infestations were reported from localized districts which were fairly well distributed throughout the sugar beet growing areas. Control measures were necessary in these areas. In Yellowstone and Carbon counties practically the entire sugar beet area was sprayed at least once. The damage was limited almost entirely to defoliation of the plants, the infestation not being severe enough to injure the crown. Heavy infestations were recorded in flax fields. Their feeding activities were confined to stripping of the leaves so it was difficult to estimate the damage. This appears to be the first time that this insect has been reported in large numbers in flax in Montana. The severity of the infestation in a flax field in Pondera County was judged from the fact that 50 to 70 pupal cases could be obtained from sifting a square foot of soil in the field.

A heavy flight of second generation moths appeared but over 90 per cent of these proved to be sterile.

A moderate to heavy flight of moths was observed during June of 1942. Owing to the high incidence of sterility among them, very few eggs were laid. Some spraying was done in Yellowstone, Carbon, and Big Horn counties. The infestation was very light and no damage was reported. Some second generation moths appeared in the northern part of the State but all of these were sterile.

SPRUCE BUDWORM.— An outbreak of the spruce budworm (*Archips fumiferana* (Clem.)) occurred on the Gallatin Forest during the summer of 1942. It was noted in large numbers on the east slope of the Bridger Range, and considerable damage was done to douglas fir (*Pseudotsuga taxifolia*), engleman spruce (*Picea engelmanni*), and alpine fir (*Abies lasiocarpa*). A trip was made into the area in the company of Mr. A. H. Abbott, Forest Supervisor, on July 10th, at which time the larvae were abundant. On August 9 no larvae were found in the same area but injury to douglas fir, especially to some of the young trees, was very evident.

The larvae collected in July were moderately heavily parasitized. Two species of parasites were reared from this collection, *Glypta fumiferana* Vier., and a species of Microgaster which is apparently undescribed according to Mr. C. F. W. Muesebeck, to whom the specimens were transmitted for determination.

ARMY CUTWORM.— During the spring of 1942 parts of the State experienced the worst infestation of the army cutworm (*Chorizagrotis auxiliaris* Grote) in several years. A large area in eastern Montana was involved, and there was considerable local crop injury. Some grasshopper bait was spread in the control of these pests.

PALE WESTERN CUTWORM. — This pest (*Agrotis othogonia* Morr.) has been extremely injurious in the State in years past.

During 1941 and 1942, however, no reports were received and no damage was seen. The moist spring of 1942 would indicate that it is not likely to be a problem during the 1943 growing season.

CORN EARWORM.— The heaviest infestation of sweet corn by the corn earworm (*Heliothis armigera* (Hbn.)) in many years was experienced during the spring of 1941. Although it was general throughout the State, the greatest damage was done in the Bitterroot Valley where many early plantings were a complete loss. Appearance of adults and egg laying occurred before the silks appeared and by the time they were well out the larvae were found in the tips of the ears. The abundance of adults early, together with the mild winter preceeding, indicate a possibility of overwintering in this region. In 1942 there were fewer of these pests than usual over much of the State and no great abundance was reported anywhere in Montana. Control is discussed in Montana Extension Circular Series A—11.

RASPBERRY ROOT OR CROWN BORER. — Raspberry plants which appear to be stunted and with little vigor, or on which the lateral spring growth wilts suddenly causing the death of the cane, should be examined for the attack of the raspberry root or crown borer (*Bembecia marginata* Harris). This injury is most apparent in old plantings and in some parts of the country is said to be a rather important pest. The only specimens in the Montana Agricultural Experiment Station collection were taken in Bozeman in August of 1938 and 1942, although reports of the occurrence of borers in raspberries on the east shore of Flathead Lake have been received.

The adult of this species is a slender, wasp-like, clear winged moth. It is rather sluggish, and may be found sitting on the leaves of raspberries or flying about the plantings late in the summer. It lays its eggs on the leaves and canes, and the larvae which hatch from these eggs bore into the canes close to the crown. They feed on the canes in the fall and pass the winter in this situation. In the spring they work their way down into the crown where they feed and pass the second winter. The larvae at this time are yellowish-white, fleshy, with the body segments showing up strongly because of the narrow constrictions between them. Pupation occurs the following spring and the new adults appear about the first of August. It thus takes two years for a generation to develop.

Besides raspberries, loganberries and occasionally blackberries are known to be attacked. Canes which are not vigorous or which shown signs of rapid wilting should be removed by cutting as close to the crown as possible. The application of a summer oil during the first ten days in August and at two-week intervals after that has been recommended to kill the eggs.

RASPBERRY FRUITWORM (*Byturis unicilor* Say).—At the time of raspberry picking it is not uncommon to find the core of the

berry mined and grooved by the feeding of a small, brown beetle larva. This larva may stay in or on the core or it may remain in the harvested fruit. In cases of heavy infestation it is necessary to cull a large percentage of the fruit, and the loss may be considerable. At certain times in western Montana populations of this insect may be very high and the loss of fruit in proportion. The larvae, which cause this damage, are about one-fourth of an inch long when fully grown. They hatch from minute eggs which are laid on the buds, flowers, or stems. When they have completed their development they drop to the ground, burrow into the soil, and pupate. The adults emerge from the soil early in the spring, feed on the unfolding leaves and flowers, depositing their eggs in or near the latter for the next generation. These adults are elliptical, yellowish-brown beetles, less than a quarter of an inch long.

Control involves the destruction of the adult beetles before they have had an opportunity to lay eggs, and their long period of feeding before egg laying gives time for this. In our experience, an application of a standard lead arsenate spray as the buds are forming, or a thorough dusting with a one-half per cent rotenone dust at the same time, and followed two weeks later with another application, will reduce the damage to a negligible amount.

SWEET CLOVER WEEVIL.– This European weevil (*Sitona cylindricollis* Fahr.) has proved itself to be highly destructive to sweet clover in the eastern part of the United States and Canada. Its injury seems to be greatest to new seedings, which sometimes have to be replanted, but it is not limited at all to these small plants. The obvious damage is caused by feeding on the leaves and stems and, according to observations which have been made in Ontario, this injury is primarily suffered by sweet clover although alsike and black medic are attacked. Although this pest is found on alfalfa and red clover, these two crops seem to be little injured.

Since the first observation of the sweet clover weevil in the United States in 1933, it has travelled rather rapidly toward the west. It was first discovered in this country at Middlebury, Vermont, and further surveys carried on during that season disclosed its presence in New York, Connecticut, and Massachusetts. In August and September of 1935 it was noted injuring sweet clover plantings in Ontario. It was reported from Manitoba in 1939, Illinois in 1940, Minnesota, eastern North Dakota, and eastern Saskatchewan in 1941, and on September 11, 1942, a good series of specimens was received in this office from Wibaux, Montana. Besides the above states it has been taken in Wisconsin, Missouri, and Iowa. It is probably more widely distributed in eastern Montana than the single record indicates.

From the first reports on this new pest it appears that its injury is quite severe to sweet clover. How injurious it will be in Montana remains to be seen. If it greatly damages this crop it will

be of considerable importance not only to the farmer but to the beekeeping industry as well.

The sweet clover weevil is a grayish snout beetle, from one-eighth to three-sixteenths of an inch long. It may occur in large numbers, from 25 to 100 per square yard having been reported. Injury to this crop should be watched for, and if beetles answering the above description are found they should be sent to the State Entomologist's Office at Bozeman.

Some insecticidal tests were tried in Ontario, but as yet no satisfactory method of control has been developed.

PEA WEEVIL.— During the past few years this pest (*Laria pisorum* (*Linn.*)) has increased in importance in some parts of Montana. The two areas most heavily infested at the present time include a region from the vicinity of Missoula to the north and west to the State line, and the Valley of the Clark's Fork of the Yellowstone from Bridger and Roberts north to the Yellowstone and including some areas near Billings. These areas were surveyed during the latter part of June, 1942, and although the pea weevil is widespread in them, there were but isolated spots where it was at all abundant.

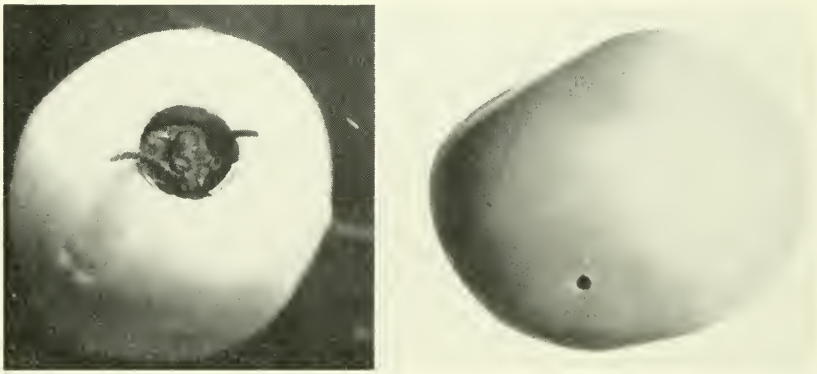

Figure 6. Pea weevil. Right, adult beetle ready to emerge from dried pea; left, injury to green pea caused by entrance of newly hatched larva. Greatly enlarged.

The apparent increase in numbers of pea weevils recently may be the result of at least two things. In the first place peas containing up to 10 per cent weevils were used for seed in some parts of the State during the spring of 1942. This certainly had an effect in the local increase of the species in areas where such seed was planted. In the second place, most of the State has experienced a series of mild winters with considerable snowfall which would allow more of the pests to live through the winter out-of-doors. The survey indicated clearly that this was taking place.

Whether the presence of this beetle in the State indicates a future of higher populations and increased difficulty, similar to other areas in the Northwest, is problematical. It has appeared in the State many times in the past and would seem to have ample opportunity to have established itself and reached maximum populations long ago. Our first records go back to March, 1912, and it has appeared periodically since then. Further, a seed company reports its presence in the Bitterroot Valley twenty-five years ago. However, this does not minimize the importance of obtaining weevil-free or adequately fumigated peas for seed, or of watching fields planted either for seed or for canning purposes, and taking adequate protective steps in case economic infestations are found.

Control of the pea weevil is discussed in Montana Extension Circular Series A-30.

BEAN WEEVIL.— The bean weevil (*Acanthoscelides obtectus* (Say)) is a beetle closely related to the pea weevil, but differing in its hosts and habits. The pea weevil will overwinter in stored peas, but will not reproduce in them. On the other hand, the bean weevil continues to breed in stored beans through the period of storage if temperatures are sufficient. While our records are doubtless incomplete, this pest seems to be much less common in Montana than the species attacking peas. We have two records, one from Bozeman, and one from Billings. It can be controlled by the usual fumigation procedures.

PLUM GOUGER.—The plum gouger (*Anthonomus scutellaris* Lec.) is the primary pest of plum fruits in the State. It apparently is present throughout the State, for it has been reported all the way from Broadus in the southeast to Polson in the northwest. It is a medium-sized weevil, bluish-brown to brown in color, with the head and thorax lighter, and with a rather conspicuous slender snout. The characteristic injury to the plums is more conspicuous than is the weevil itself. The skin is punctured, and the pulp beneath fed upon. The eggs are laid in holes somewhat similar to the feeding punctures, and upon hatching the young larvae bore directly into the pit, feeding there until they are fully grown. Pupation takes place in the pit and the adults emerge in late August or in September. They feed very little that season, and soon find sheltered quarters for winter hibernation. In the spring they emerge and feed on the buds and leaves.

To control these pests the trees should be sprayed with the usual lead arsenate sprays before the blooms have opened, and at ten-day intervals until the fruit is well developed.

PLUM CURCULIO.— In the First and Second Reports of the State Entomoligist, Cooley reported that the plum curculio (*Conotrachelus nenuphar* Herbst) was possibly present in the Bitterroot Valley in western Montana. In 1922 apples at Hamilton bore typical scar injury of this pest. Not until June 1942, though, were specimens

actually taken in Montana, when a mixed collection of this species and the plum gouger was received from Miles City.

The plum curculio is a "broad-shouldered" snout beetle about a sixth of an inch long, brown or black in color with lighter markings and with rough-looking wing covers. It is primarily a pest of stone fruits, but may cause considerable injury to apples. Feeding punctures are quite similar to those of the plum gouger. The egg punctures are characteristic of the species. After the egg has been placed beneath the skin, the female turns around and makes a crescent-shaped slit partially around and beneath the egg cavity. This type of wound is not made by the plum gouger and will serve to indicate whether or not the plum curculio is present.

The larvae burrow into the fruit and lie next to the pit, and the fruit often drops prematurely. Pupation is in the soil and in about a month the new generation of beetles appears above the ground. They may feed for some time in the fall, after which they hibernate in protected places.

Injury caused by this pest can be greatly reduced by spraying the trees with lead arsenate. The first application should be made just after the petals have fallen and a second, ten days later.

SEED-CORN MAGGOT.— This pest (*Hylemia cilicrura* Rond.) was especially abundant in the Yellowstone Valley during the spring of 1942, more so than in many years. The spring was very wet and cool, and the growth of crops retarded, a combination of factors which would be expected to bring on an infestation of these insects. As a usual thing this injury is limited to crops in soils rather rich in humus, but during the last spring conditions were such that bean plantings on light sandy soils showed from 10 to 30 per cent loss by the middle of June. Injury reported or observed included an area from Bozeman east and north to Froid, and seemed to center in the Yellowstone Valley near Billings, and up the Clark's Fork of the Yellowstone to a point well beyond Bridger.

Corn and peas were attacked to some extent, but by far the greatest damage was suffered by beans (figure 7). It was necessary to replant many of these fields. Usually eggs are laid in moist soil where there is plenty of decaying vegetation. The larvae may feed as scavengers on this material, but when succulent sprouting plants or large soft seeds are present they make their way into these. The larvae are typical fly maggots, cylindrical, pointed at the front end, and dirty white in color. When the infested area around Billings was visited on June 18, 1942, the adult flies were emerging from the soil in large numbers. These flies are smaller and more fragile looking than a house fly, and more grayish-brown in color.

Thorough mixing of the vegetable matter in the soil, and any cultural procedure which will tend to dry out the surface of the ground will assist in reducing the damage caused by this pest.

Figure 7. Injury to bean seedlings caused by the seed corn maggot.

MINK MAGGOTS.— On June 16, 1941, live maggots were recovered from mink pups in Helena by the Livestock Sanitary Board, and transmitted to this office for examination. On the 18th two of them were placed in moist sand. These pupated and emerged on July 1 and 2, and were identified as flesh flies belonging to the species *Wohlfahrtia meigeni* (Schin.). This and the related eastern species *(W. vigil)* not uncommonly attack living animals such as foxes, rabbits, dogs, and mink, and there are a good many records of *vigil* attacking humans, especially small children. In the case at hand the maggots were apparently the cause of the death of the mink pups.

Wohlfahrtia meigeni was first obtained for the Montana Agricultural Experiment Station when specimens were collected on May 29th, 1907, in Bozeman. Since then other specimens have been taken at Helena and Rapelje, and it probably enjoys a state-wide distribution.

CABBAGE MAGGOT (*Hylemia brassicae* (Bouche)) ON TURNIPS. Early turnips grown in the Billings area for table use were disfigured in the spring of 1942 by larval tunnels of the cabbage maggot. Adult flies emerged June 25-30 from mature larvae and

pupae collected June 20 in soil along the turnip rows. Attack on nearby cabbage plants was noticeable, but not severe.

Damage from this maggot is most severe in cool, moist seasons. Adult flies appear in May and lay eggs in soil crevices on or near the roots of cabbages, radishes, and turnips. The larvae are destructive by riddling or disfiguring the plants below the soil surface. Young plants may be protected by soaking the soil around the roots with calomel (mercurous chloride) ¾ ounces and 1 ounce of gum arabic to 10 gallons of water. The material may be applied to the soil along the row by sprinkling can, coarse sprayer, or a cup. Ten gallons of the liquid will treat about 400-500 plants.

WHEAT STEM SAWFLY.— This broad-waisted wasp *(Cephus cinctus* Nort.*)* is a native Great Plains insect. Originally it lived on native grasses, and when large acreages of this vegetative cover were plowed up and replaced with cultivated small grains it transferred to these crops. In Montana it is most abundant and injurious in the eastern plains area north of the Missouri River, and during the last few years it has destroyed a great deal of wheat in this region.

The larva of the wheat stem sawfly weakens the wheat straw an inch or two above the ground level, and as the stems dry and the grain matures they break over and lodge. At the beginning the injury is of a marginal nature, being the worst around the edges of the field. Because of this, strip cropping, in infested areas, is likely to suffer greater injury than large, solidly blocked fields.

The life history and control of this insect can be obtained from Montana Extension Bulletin 176, or from Montana Extension Circular Series A-37.

EARWIGS.—The European earwig *(Forficula auricularia* L.*)* was first reported from the State in the last State Entomologist's Report. During the past two years two new infestations have been located. Besides previous records we now know of their occurrence in Missoula and at Bozeman Hot Springs, just west of Bozeman. The third specimen of the little earwig *Labia minor* L. to be collected in Montana was obtained in August, two miles south of Bozeman. Both of these species seem to be well established in the State at the present time.

BIENNIAL REPORT OF THE MONTANA STATE APIARIST, 1942

J. F. Reinhardt, State Apiarist

THE BEEKEEPING INDUSTRY IN MONTANA

Approximately 36,000 colonies of bees are operated in Montana. They produced about 4,600,000 pounds of honey and 150,000 pounds of beeswax for a gross income in 1942 of slightly over one-half

million dollars. A unique fact is that Montana reports the largest average crops of honey per colony in the United States, almost three times that of the national average for the past three years. This report has created some illusions about Montana beekeeping territory. However, two main factors contribute to any honey crop record, the operator and the territory, and credit for this record is due, really, to a small group of 75 professional beekeepers who own and operate 93 per cent of the bees in the State. Another avocational group of 60 operates 4.6 per cent and an amateur group, 70 per cent of the beekeepers in the State, operate 2.4 per cent of the bees.

Distribution of bees by registration group is illustrated by figure 8. These data seem to indicate that Montana's production is due to a combination of efficient commercial management plus good territory. In other states commercial management has pro-

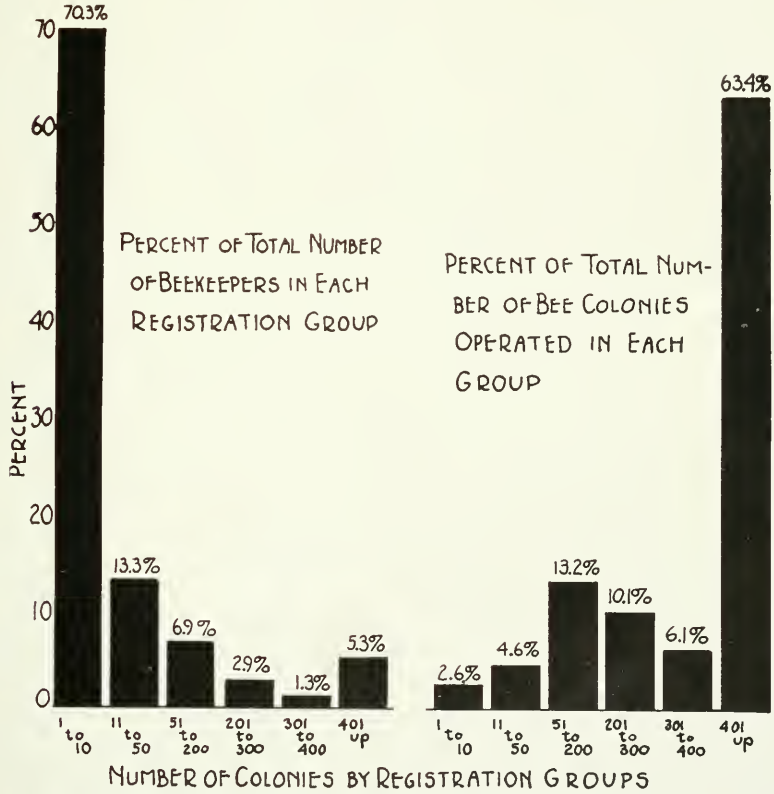

Figure 8. Distribution of bee colonies and beekeepers by registration groups.

duced better records though they are not reflected in statistics because the proportion of commercially operated bees is much smaller in those states.

DISEASE CONTROL

Paramount among the problems of all classes of beekeepers in the State is the disease, American foulbrood. Montana had no State-supported disease control program during the period 1933 to 1941. This relaxing of control permitted a marked rise in the incidence and spread of the disease. Many amateur and several professional beekeeping operations died out with the bees. Some apiaries of 40 to 50 colonies were simply abandoned with the hives left on the stands, bees dead and honey robbed out. Commercial beekeepers strove to keep territory free of disease by buying out small apiaries to burn them and salvage what was profitable. To render some inspection service of value to the State as a whole with extremely limited funds it was necessary to form an inspection policy around certain facts. The commercial beekeeper in infected territory knows American foulbrood and how to fight it in his own apiaries. He has to fight the disease to stay in business, whereas the amateur and avocational beekeeper knows little about the disease, is often indifferent, and it is not essential to his livelihood to practice disease control. Hence, the most urgent inspection appeared to be among the beekeepers of the amateur and avocational classes. Conditions further indicated the necessity of carrying out the control measures by the inspector. If control is left to individual owners only about 50 per cent of them will carry out the control, and the entire purpose of inspection is defeated. Hence, diseased bees are usually burned on the spot as promptly as possible.

It must be kept in mind that the inspection record includes mostly amateur and non-professional beekeepers, and represents conditions only among those classes. Since there is no prospect in the immediate future for the inspection of all commercial bees, the State Apiarist is impelled to exercise a policy of depending on commercial beekeepers to control disease in their own apiaries. In exceptional cases the inspection of commercial apiaries has been definitely warranted. However, in general, the profit motive is an incentive for the commercial man to clean up and salvage diseased bees as efficiently as possible.

Montana has about 500 box hives without modern movable combs (generally regarded as impossible to inspect). The State Apiarist has found it not only possible, but in numerous cases effective to inspect these hives. The procedure is simple in most cases. The hive is tipped over and the bottom pried off with a large hive tool made from an automobile spring. The combs can then be folded back and forth like leaves of a book to inspect the brood for sunken and perforated cappings. If that is not satis-

factory, a comb of emerging brood can be jerked out for more thorough examination. The comb is replaced in the slot, the bottom nailed back and the hive set up. The box hive is either dis-

TABLE 5. INCIDENCE AND DISTRIBUTION OF AMERICAN FOULBROOD IN APIARIES INSPECTED IN 1941 AND 1942

County	Colonies inspected	Colonies A. F. B.	Apiaries inspected	Apiaries infected
		1941		
Big Horn	608	286	10	9
Cascade	77	13	16	2
Flathead	47	23	16	7
Gallatin	143	24	19	7
Lake	602	211	99	33
Madison	64	0	5	0
Pondera	47	23	16	7
Ravalli	486	53	45	20
Sanders	150	27	25	6
Teton	18	0	5	0
Yellowstone	136	16	18	7
Other	150	5	4	2
Totals	2528	681	278	100
		26.9%		36%
		1942		
Blaine	288	57	10	5
Carbon	80	39	5	5
Cascade	41	22	5	2
Chouteau	2	0	1	0
Dawson	28	0	3	0
Fergus	130	30	28	6
Flathead	150	17	38	8
Gallatin	91	6	13	3
Jefferson	4	2	3	1
Lake	280	46	78	21
McCone	7	0	3	0
Park	24	0	5	0
Phillips	23	5	7	2
Pondera	71	24	15	2
Ravalli	489	69	51	15
Richland	28	0	7	0
Sanders	123	3	20	1
Stillwater	46	19	3	3
Sweet Grass	22	8	4	2
Teton	19	0	4	0
Valley	68	23	11	4
Yellowstone	329	62	29	11
Totals	2343	432	343	91
		18.4%		26.5%

eased or it is not. The inspector seldom arrives at the moment the first diseased cell appears. This method in no way excuses box hives and the human lethargy and indifference that go with them. It has simply proved expedient where it takes two minutes to inspect a hive but two hours to burn it if orders to transfer are not heeded. Needless to say the above technique is not effective on bees in wash boilers, barrels, chicken brooders, dog houses, and ice cream freezers though all are on record in the State.

In those counties where inspection is reported for both 1941 and 1942 we have a partial measure of how effective the disease control program has been. A review of the number of infected apiaries (foci of infection) indicates that in most counties the number is being reduced. Noteworthy is the case of Sanders County where in 1942 the disease was found in only three hives in one apiary. It is possible that two years' inspection will achieve complete eradication in this county. Other counties with larger areas of beekeeping territory do not show such marked reductions. Of the 608 inspections in Big Horn in 1941 all but three were in commercial apiaries. In Yellowstone County the inspection of new territory and of certain commercial apiaries together with an unfortunate outbreak of disease from one focus of infection combine to cover up what progress has been made. In Flathead, Lake, Pondera, and Ravalli counties considerable territory not previously inspected was covered in 1942, yet definite decreases in the incidence of disease and the number of foci are indicated.

The disease conditions among the 33,500 commercially operated bee colonies is another story since very few were inspected by the State Apiarist. The annual loss is estimated at 5 per cent, occurring as would be expected according to a contagious distribution. Some operators have been absolutely free of disease for years, most operators are sufficiently hampered to require several regular inspections annually and about 5 per cent loss of profits. Occasionally the incidence of disease rises to the loss of entire commercial losses have been distinctly cut down and avoided. But

In the counties where there are numerous amateur beekeepers commercial losses have been distinctly cut down and avoided. But in several other areas inspection has shown little progress in warding off these financial losses. The answer is that disease in a neighboring beehive is only one of a number of factors involved; others are the present labor shortage (making adequate inspection and disease control difficult), lack of equipment, vandalism, and most important, the failure to practice positive swarm control measures in years past. It is usually assumed the "wild" bees in trees, rimrocks, and buildings very seldom have disease. Explanations may vary, but high among them is that involving the presence of the greater wax moth which quickly destroys the combs in a dead hive. Montana has practically no wax moth. Coincident with

the absence of the wax moth, territory in Montana may be very easily infected with American foulbrood. Swarms in trees and rock ledges become infected and die out. In turn the combs are robbed, another swarm takes possession, stores a little honey and the story is repeated. How permanent these reservoirs of infection are is only a conjecture. But the adage is well illustrated that **swarm control is disease control.**

Various measures have been tried by beekeepers to avoid infection from the territory—package bees, winter locations, crop locations and bee-tree hunting. The most promising solution appears to be the use of disease-resistant bees in locations where disease is frequently picked up.

UTILIZATION OF MONTANA'S BEEKEEPING RESOURCES

The Montana apiculture laws vest the State Entomologist with an unusual authority:

> "Before a permit for the movement of bees into the State may be granted, it shall be determined by the State Entomologist that the territory to which movement is requested shall not be over-crowded and such movement shall not be detrimental to the best interests of the beekeeping industry. Beekeepers shall be notified of any request for the movement of additional bees and equipment into their established territory and shall have thirty days in which to enter any protest or reason why this permit shall not granted.
>
> "The State Entomologist may in his discretion authorize permits for the shipment of bees on combs into Montana."

This is a historic clause because, though only indirect, it grants legal authority to recognize a commercial beekeeper's ethical right to keep bees in a certain place to the exclusion of certain other commercial beekeepers. It is the beekeeper's effort to sacrifice some liberty and thereby gain some security.

Overstocking of western territory has frequently resulted in a demoralizing influence on the industry. In few businesses are the operators in more direct and complete competition with each other. When beekeepers have to compete for territory friction often develops which may lead to criminal malpractices. There are some signs of actual overstocking of territory in certain parts of the State. If Montana is the best beekeeping territory in America (as the U. S. Bureau of Agricultural Economics reports) it is only natural that Montana beekeepers are jealous of their territory. All of the beekeeping industry is located in the narrow irrigated valleys which embrace 1.5 per cent of Montana's total area, or an area approximately equivalent to the State of Delaware. Hence her beekeeping resources are not unlimited. That limit may not be known until it is exceeded.

Permission to enter bee colonies from out of State to territory now well occupied by commercial beekeepers has been refused. These actions have had a surprising effect. When newcomers are given to understand they cannot crowd their way in they are all the more desirous of coming in. They seek this new protection, slight as it is. The actual result has been that beekeepers wishing to move outfits into Montana have sought out unused territory of value and are putting it into production. Far from being a State trade barrier, an unprecedented number of bees have entered and are entering the State. For the period July 1, 1941 to June 30, 1943, the total entries granted or pending are 6,700 colonies, over one-fifth of Montana's bees in 1941. Small as this regulation may seem it has increased Montana's beekeeping industry and avoided the abuses of overstocking. What the policy will be when the frontier disappears we cannot predict though that time is not far away. Nor do we know whether the Montana regulation is a step in the ultimate control of beekeeping territory on a priority basis. Though it has achieved a result which we believe to be highly satisfactory, it has not been easy to administer.

Another opportunity to utilize Montana's honey resources receives little attention. There are many spots where it is not practicable for commercial beekeepers to operate because of the distances to be traveled and the small productivity of the areas. Some avocational and amateur beekeepers have been remarkably successful in these small geographically isolated localities where they live. The ranks of the avocational one-apiary beekeeper could be swelled many-fold. There is no transportation problem, the territory supports small apiaries well, and if the crop should fail the operator is not dependent on it for a livelihood.

At the same time it should be noted that practically no line of agricultural endeavor has more people who dabble at it more or less unsuccessfully. The success of the amateur beekeeper is directly proportioned to his knowledge and skill in managing bees, and the average amateur beekeeper is not a successful one. Indeed, the actual experience of many an amateur is in shaking a swarm off a bush so it may enter a box. Sometimes the entire knowledge of apiary management is included in shaking a bush. The crop may not be harvested at all and the hive never opened from the time the inspector visits one year until he visits again the next year.

The answer to this problem is an active extension program. Perhaps the most potent extension tool is the actual inspection of apiaries. When the owner is indifferent nothing is achieved beyond actual inspection. But personal contact arouses interest and leads to the solution of problems. Hundreds of bulletins, lists of literature, and supply catalogues have been circulated by personal contact and by mail.

The last spring short course in Flathead County, called by Mr. Leonard Eliason, County Agent, seemed to be quite successful. An average number of ten persons attended four three-hour meetings on consecutive days. Small attendance was compensated for by the interest and enthusiasm of the group. Nowhere else in the State is amateur beekeeping conducted on such a high level of success as in the vicinity of Whitefish. Here amateur beekeeping reflects the results of the short course and the friendly personal influence of one skillful beekeeper. Short courses may show good results in areas where the population is of sufficient density to yield an interested group. But in many sparsely settled isolated areas distance is a controlling factor. When funds and organization permit a more active extension program a correspondence course or radio lecture series would serve a useful purpose where short courses would prove impractical. Present policy has been to focus as much time and attention as possible on the problem of disease control.

BEEKEEPING AND THE WAR EFFORT

Beekeeping occupies a rather significant though somewhat obscure place in Montana's agriculture. In the products, honey and beeswax, we find an essential food and an extremely critical war material. Honey exists as a luxury in minds of many individuals. But honey is sugar, or more exactly, a water solution of natural sugars. It displaces an equivalent amount of granulated sugar in the diet. It behaves as a sugar supplement in the market. Sugar shortages created a honey boom during World War I and the story has been repeated in 1942. Limited shipping has cut off our imports of beeswax as well as sugar. During normal times we import half of the beeswax we consume. Domestic production must now supply the entire load. The demands for beeswax for ammunition grease, finishes, waxes, polishes, leather dressings, machine patterns, pharmaceuticals, dental impressions, must and will be met; demands for modeling, cosmetics, candles and other industrial uses probably will not be met.

Still the most important contribution of bees is not that of honey and wax. The production of fruits, certain vegetables, leguminous forage crop seed is largely dependent on the services of honey bees in the pollination of blossoms. For example, studies by the Montana Agricultural Experiment Station on sweet cherries in Lake County showed that orchards where bees were provided had a blossom set two and one-half times that of orchards farthest distant from bees. By flower visitation bees have entered the production lines of fruits, vegetables, dairy products, meats, leather, and wool, and thus have taken an essential place in a balanced agriculture.

In view of the war effort the U. S. Department of Agriculture called for as large an increase as possible in the production of honey and wax in 1942, and increased cooperation with other agricultural producers who need the pollination services of bees. With this recommendation came the warning that beekeeping is a skilled profession; and, though now is as good a time as any to learn it, amateurs without experience cannot expect to jump in with borrowed capital and make a commercial success of it. This recommendation together with higher prices and War Production Board quotas and priority ratings has resulted in increasing commercial operations by about 20 per cent in 1942, with a proportionate increase in production. Due to irregularities of the weather over the country as a whole, Montana is one of the few states that showed an actual increase in production in 1942. This was achieved by the expansion of existing outfits and also the movement of approximately 2500 colonies into the State. The policy of permitting movement of bee colonies from other states to unused beekeeping territory is increasing the pollination service to legume crops in those areas.

The repercussions of the war on the beekeeping industry have been and will be increasingly felt. Existing machinery and equipment in honey plants have been on the whole adequate. One exception is that higher prices and increased demand make it profitable to pay much more attention to wax production. Many outfits are inadequately equipped for wax handling and wax presses are no longer available. Rubber truck tires will be increasingly critical material. Modern commercial bee culture is based on motor truck transportation from out-apiaries to warehouse and back. Constant use during the season and the margin of profit makes it very impractical to attempt to satisfy this need with commercial vehicles and common carriers. The real shortage will be felt in 1943 and 1944 as present rolling stock wears out. Tires will be absolutely essential to maintain production. The labor shortage has become critical to the point where labor is the controlling factor in maintenance of production. Many outfits were expanded this year without increasing the number of hired helpers. Some of those workers were deferred from the Armed Forces only for the current season. In several cases the owners have planned killing their bees and liquidating their assets in preparation to induction in the Armed Forces. Women and 'teen-age boys are being used with considerable success in extracting plants and shops. But the work in the apiary requires strong backs. Operators are in a quandary over what proportion of their bees should be killed off this fall. If more bees are wintered than they will have labor to handle next year, those bees plus the honey they consume over winter may represent considerable loss. The recent Selective

Service System ruling that the profession of beekeeper be classed as one of the critical agricultural occupations may alleviate the situation and allow the maintenance of present production levels.

The picture is not entirely black. Price control of extracted honey and wax has been a source of confusion, but beekeepers have willingly accepted the principle of price control. Present ceilings allow them to show a reasonable profit on the books for the first time in many years. With this salvation from financial uncertainty and the abundant recognition of the place of bees in our common way of life, the beekeeper deserves and now has a portion of his reward for persistence and service during the lean years of the last depression.

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